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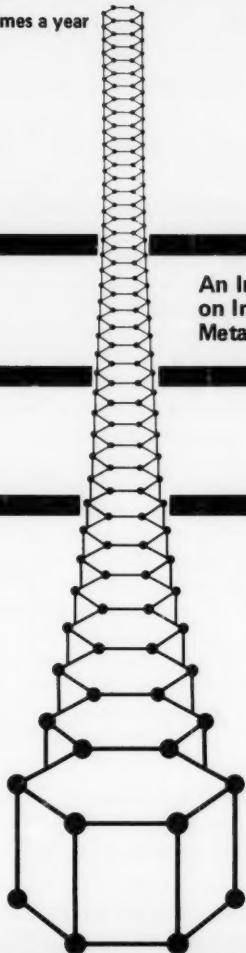
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Handbook on the Physics and Chemistry of Rare Earths, Volume 11

Two-Hundred-Year Impact of Rare Earths on Science

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This volume celebrates the contribution of rare earth research to the development of science since these elements' published discovery two centuries ago.

The prologue is a biographical sketch of F.H. Spedding, who contributed extensively to rare earth science during more than fifty years of published research. The discovery and separation of the rare earths is narrated by Szabadváry, who has succeeded in lighting many dark corners of this confusing history and hence provides many new scenes in this lively yet serious saga. The techniques of atomic spectroscopy were applied immediately upon this development to the identification of the new rare earths, dashing the claims of many and confirming those of others. Judd provides a definitive and perceptive account of the further success in the use of this science during the past sixty years to clarify the electronic configurations of the rare earths. Jørgensen records his own special insights into the idiosyncratic chemical behaviour of these seventeen elements. The scope of this treatment begins with their primordial formation in the stars and includes the chemical basis of their classification and integration into the fabric of science. Magnetism in the lanthanides has been of interest at least since the observation of ferromagnetism in gadolinium by Urbain in 1935. Since that time these materials have been the centre-stage in the development of magnetic theory and advanced applications. Two chapters emphasize the unique role played by these elements in understanding magnetic interactions. The first chapter by Rhyne highlights certain exotic magnetic phenomena in the lanthanide metals and alloys, and the second, by Bleaney, considers the general field of magnetic resonance spectroscopy and hyperfine interactions, including a description of the modern techniques that generate this information. The metallurgy of rare earths is discussed by Gschneidner, Jr. and Daane, two of the most active in this area during its rapid ascension. Finally, Taylor and McLennan show how the progressive change of chemical and physical properties of the series, with the useful discontinuous exceptions, find especial use in revealing the progress of geochemical and geophysical processes in the formation of many of earth's features and analogous ones of the heavenly bodies.

The reader of any chapter of special interest in this volume will find reference to sections of other chapters that give extended coverage of some aspects of the same topic of interest. This underlines the breadth of the impact on science of the discovery, separation and study of the rare earths.

Contents: Preface. Contents of volumes 1-10. Prologue (*H.J. Svec*). The history of the discovery and separation of the rare earths (*F. Szabadváry*). Atomic theory and optical spectroscopy (*B.R. Judd*). Influence of rare earths on chemical understanding and classification (*C.K. Jørgensen*). Highlights from the exotic phenomena of lanthanide magnetism (*J.J. Rhyne*). Magnetic resonance spectroscopy and hyperfine interactions (*B. Bleaney*). Physical Metallurgy (*K.A. Gschneidner, Jr. and A.H. Daane*). The significance of the rare earths in geochemistry and cosmochemistry (*S.R. Taylor and S.M. McLennan*).



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Chemistry and Physics of Matrix-Isolated Species

edited by L. Andrews, University of Virginia, Charlottesville, VA, USA, and M. Moskovits, University of Toronto, Toronto, Ontario, Canada

Matrix-isolation spectroscopy, as a technique for studying unstable species, has had tremendous lasting powers. Since 1954, matrix-isolation has been able to assimilate new technology rather than being replaced by it. Conferences celebrating its results have become thriving enterprises.

The matrix-isolation technique for producing and trapping new chemical species has been applied to an ever increasing range of chemical and physical problems since its inception. The last 12 years have seen a substantial number of new developments and applications of the matrix technique. The chapters in this book describe many of the contributions of matrix-isolation spectroscopy to chemistry and physics in the last decade, and as such predict the continued evolution of this technique over the next decade.

Experimental techniques are generally closely related to the development of new apparatus, and each chapter has a section describing innovations in instrumentation such as the closed-cycle cryogenic cooler that has revolutionized the technique. In addition, each chapter describes many of the specialized methods used to prepare, trap and study particular new subject species. The commercial availability of closed-cycle coolers to replace liquid hydrogen and liquid helium has made the technique available to substantially more workers, and further refinements in apparatus or developments of new instruments (such as commercial lasers and FTIR instruments in the 1970s) will foster new applications and new chemical and physical studies.

The volume will be an indispensable reference source for graduate students and other scientists new to this field, as well as chemists and physicists already involved in applied spectroscopy.

Contents: 1. Introduction and Experimental Developments (*L. Andrews, M. Moskovits*). 2. Absorption Spectroscopy of Molecular Ions and Complexes in Noble-Gas Matrices (*L. Andrews*). 3. Matrix-Isolated Metal Clusters (*M. Moskovits*). 4. The Stabilization and Spectroscopy of Free Radicals and Reactive Molecules in Inert Matrices (*M.E. Jacox*). 5. Time-Resolved Laser-Induced Fluorescence Studies of the Spectroscopy and Dynamics of Matrix-isolated Molecules (*V.E. Bondybey*). 6. Chemistry on Ground State and Excited Electronic Surfaces Induced by Selective Photoexcitation in Matrices (*H. Frei, G.C. Pimentel*). 7. Production Methods for ESR Studies of Neutral and Charged Radicals (*L.B. Knight, Jr.*). 8. Reactive Organic Species in Matrices (*I.R. Dunkin*). 9. Inorganic and Organometallic Photochemistry (*R.N. Perutz*). 10. Reactions of First-Row Transition Metal Atoms and Small Clusters in Matrices (*R.H. Hauge, Z.H. Kafafi, J.L. Margrave*). 11. Energy Transfer and Lifetime Studies in Matrix-Isolated Molecules (*H. Dubost, F. Legay*). 12. Solid-State Aspects of Matrices (*H. Jodl*). Subject Index.

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THEORY OF TOKAMAK PLASMAS

by R.B. White, *Princeton Plasma Physics Laboratory, Princeton University, NJ, U.S.A.*

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Theory of Tokamak Plasmas is a graduate textbook on tokamak physics, designed to provide a basic introduction to plasma equilibrium, particle orbits, transport, and those ideal and resistive magnetohydrodynamic instabilities which dominate the behavior of a tokamak discharge, and to develop the mathematical methods necessary for their theoretical analysis.

Primarily the book covers the consequences of ideal and resistive magnetohydrodynamics, these theories being responsible for most of what is well understood regarding the physics of tokamak discharges. The focus is on the description of equilibria, the linear and nonlinear theory of large scale modes, and single particle guiding center motion, including simple neoclassical effects. Modern methods of general magnetic coordinates are used, and the reader is introduced to the onset of chaos in Hamiltonian systems in the discussion of destruction of magnetic surfaces. Much of the book is devoted to the description of the limitations placed on tokamak operating parameters given by ideal and resistive modes, and current ideas about how to extend and optimize these parameters.

To a large degree the book is self contained and most chapters depend logically on material developed previously. The course is aimed at second year graduate students, but by changing emphasis on the subjects presented it could also be given to first year students or even to undergraduates with some previous plasma physics training. The material could also be expanded and taught at a more advanced level by using the text as a base.

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